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U.S. PATENT APPLICATION

for

HEATING AND AIR-CONDITIONING SYSTEM FOR A MOTOR VEHICLE

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BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The invention relates to a heating and air-conditioning system for a motor vehicle, having a conditioning housing in which at least one heat exchanger is integrated and which has a plurality of air outlet openings for guiding air to front interior zones of the motor vehicle.

2. Description of Related Art

[0002] Heating and air-conditioning systems, in general, are known. In one known heating and air-conditioning system having a simple design, temperature control is possible only in the front interior zones, and no additional temperature control at the rear is provided. Heating and air-conditioning systems of this type are used, particularly in relatively small passenger vehicles.

[0003] Heating and air-conditioning systems of a more complicated design are also known (DE 197 31 908 A1 or FR 27 78 152 A1 or US 5 862 677 A). In these heating and air-conditioning systems, temperature control of the rear interior zones is provided in addition to temperature control of the front interior zones. The heating and air-conditioning systems illustrated in the above-mentioned publications have relatively large conditioning housings in which all of the temperature-control and the control and air-guiding functions both for the front interior zones and for the rear interior zones are integrated. By means of these more complicated heating and air-conditioning systems, individual temperature control of the rear region or of the front region of the particular motor vehicle is possible. Such heating and air-conditioning systems are particularly suitable for relatively large, well-equipped passenger vehicles.

[0004] Therefore, depending on the desired design of a given motor vehicle, different conditioning housings must be produced and fitted accordingly.

SUMMARY OF THE INVENTION

[0005] An object of the invention is to provide a heating and air-conditioning system of the type discussed above with simple means that can be used as a system for controlling the temperature only at the front or as a system controlling the temperature at the front and rear, depending on the requirement of a given application.

[0006] In accomplishing the objects of the invention, there has been provided according to one aspect of the invention a heating and air-conditioning system for a motor vehicle, comprising a conditioning housing; a first heat exchanger operably integrated within said conditioning housing; a plurality of air outlet openings in said conditioning housing for guiding air to front interior zones of a motor vehicle; a connecting section on the outside of said conditioning housing; an air outlet opening through said connecting section; and selection either means for selectively attaching to said connecting a releasable cover for covering, in a tight, leak-proof manner, said air outlet opening through said connecting section; a rear temperature control unit attached in a tight/leak-proof manner to said connecting section and in fluid communication with said conditioning housing via said air outlet opening through said connecting section.

[0007] According to another aspect of the invention, there is provided a motor vehicle comprising a heating and air-conditioning system comprising a conditioning housing; a first heat exchanger operably integrated within said conditioning housing; a plurality of air outlet openings in said conditioning housing for guiding air to front interior zones of a motor vehicle; a connecting section on the outside of said

conditioning housing; an air outlet opening through said connecting section; and selection either means for selectively attaching to said connecting a releasable cover for covering, in a tight, leak-proof manner, said air outlet opening through said connecting section; a rear temperature control unit attached in a tight/leak-proof manner to said connecting section and in fluid communication with said conditioning housing via said air outlet opening through said connecting section.

[0008] In accordance with an additional aspect of the invention, there is provided a conditioning housing for a heating and air-conditioning system that can be adapted to produce either a two-zone, three-zone or four zone system, comprising a heat exchanger operably integrated within said conditioning housing; a connecting section on the outside of said conditioning housing; an air outlet opening through said connecting section; and either means for selectively attaching to said connecting section (i) a releasable cover for covering, in a tight, leak-proof manner, said air outlet opening through said connecting section; or a rear temperature control unit attached in a tight/leak-proof manner to said connecting section and in fluid communication with said conditioning housing via said air outlet opening through said connecting section.

[0009] Further objects, features and advantages of the present invention will become apparent from the detailed description of preferred embodiments that follows when considered together with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The invention is explained in detail below with reference to the exemplary embodiments and with reference to the accompanying drawings, in which:

Figure 1 depicts, in a sectional illustration, a first embodiment comprising a heating and air-conditioning system according to

the invention that provides for both front and rear temperature control,

Figure 2 shows a heating and air-conditioning system similar to Figure 1, which is provided merely for front temperature control,

Figure 3 shows a further embodiment of a heating and air-conditioning system according to the invention similar to Figures 1 and 2 with rear ventilation,

Figure 4 shows a further embodiment of a heating and air-conditioning system according to the invention with a combined front and rear temperature control,

Figure 5 shows a detail of a heating and air-conditioning system similar to Figure 4 with a rear temperature control,

Figure 6 shows a further embodiment of a heating and air-conditioning system similar to Figure 4 with only front temperature control, and

Figure 7 shows a partial section along the sectional line VII-VII of the heating and air-conditioning system according to figure 4.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0011] The invention provides for a conditioning housing having on the outside a connecting section which is provided with at least one air outlet opening. The connecting section is intended to connect the conditioning housing to an optionally attachable rear temperature-control unit. When not in use, the connecting section can be closed tightly, in a leak-proof manner, by a releasable cover. According to the invention, therefore, the conditioning housing forms a basic module to which an additional module such as a corresponding rear temperature-control unit can be attached in a simple manner. If, in addition, rear temperature control is also desired, then, according to the invention, an additional unit has merely to be attached to the existing conditioning housing, and it is not necessary to

produce a new housing. Therefore, the solution according to the invention is suitable for both simple designs where only front temperature control is desired and more complicated designs where a rear temperature control, which can be set individually, is additionally desired. A front-zone heating and air-conditioning system can therefore be converted into a front- and rear-zone heating and air-conditioning system with a substantially reduced outlay on development and production. As a result, it is also possible to retrofit a heating and air-conditioning system of this type, having a simple design, at a later time. The heating and air-conditioning system may, depending on the design, also be provided with a left/right separation both for the front temperature control and for the rear temperature control. In this case, independent temperature control is possible for the driver's side and the front-passenger's side. According to the invention, the term temperature control is intended to encompass heating, cooling and simple ventilation.

[0012] In a refinement of the invention, an air guiding arrangement leading to the rear is provided as the rear temperature-control unit. As a result, the rear zone can be ventilated. If a left/right separation of the temperature control is provided at the front, then, together with the rear zone, a total of three zones are produced which can be individually temperature-controlled.

[0013] According to a further aspect of the invention, the rear temperature-control unit has an additional housing in which at least one air control element and/or a heat exchanger is/are integrated. The additional housing preferably forms a further air distributing space which, in conjunction with the additional heat exchanger, makes possible individual temperature control of the rear region. If the heat exchanger is provided with a left/right separation, a total of four individually settable temperature-control zones in the front and rear region are produced.

[0014] In another preferred embodiment of the invention, the connecting section is substantially larger than the air outlet opening, and the additional housing has an open housing section which can be attached tightly, in a leak-proof manner, to the connecting section of the conditioning housing. Therefore, the connecting section provided in the region of the housing wall of the conditioning housing takes on an additional function as a housing wall for the additional housing. This results in savings on construction space.

[0015] In a further preferred aspect of the invention, the connecting section and the rear temperature-control unit are provided with flange members which correspond to one another and can be fitted together. As a result, the rear temperature control unit can be securely positioned and centered. Tight, leak-proof attachment of the rear temperature-control unit to the conditioning housing is therefore ensured with interposition of suitable sealing means. The securing of the tight, leak-proof fit of the rear temperature-control unit to the connecting section is ensured by fastening means engaging in a bonding, frictional or interlocking manner.

[0016] In yet another refinement of the invention, the heat exchangers are provided with water or air regulating means. In the case of the water regulating means, there are preferably integrated in the heating unit a plurality of PTC elements which can be activated electrically via an electronic regulator. In the case of the air regulating means, the quantity of air flowing through the corresponding heating unit is controlled at the input and/or output of the heating unit by air flaps.

[0017] Turning now to the drawings, the heating and air-conditioning systems described below are provided for use in passenger vehicles and are of modular construction enabling different temperature-control variants to be produced. As discussed in the description of related art above, the basic structure and the arrangement of heating and air-

conditioning systems in motor vehicles in general, are known, so a more detailed explanation is not provided here.

[0018] The heating and air-conditioning system according to Figure 1 has a conditioning housing 1 in which an evaporator 2 is arranged. The evaporator 2 is supplied with air via a fan, which is typically included but has not been depicted or described in greater detail here for the sake of clarity. The air then passes into a first air distributing space 3. A heating unit 4 which is provided with a water regulating means is arranged in an upper part of the housing 1. For this purpose, a regulator 5 is integrated into a water box of the heating unit 4 and is used for the electrical control of PTC heating elements, which are typically included but have not been illustrated here for the sake of clarity, within the heating unit 4.

[0019] The heating unit 4 and the conditioning housing 1 are provided with a left/right separation by, as shown for example in Figure 7, a partition 28 in the conditioning housing 1. The partition makes independent temperature control on the driver's side and front-passenger's side possible.

[0020] Provided in the conditioning housing 1 on the output side of the heating unit 4 is a further air distributing space 6 which conducts the air, which, if appropriate, has been temperature-controlled by the heating unit 4, to various air outlet nozzles 8, 9, 20 of the front zone of a vehicle interior of a passenger vehicle. For this purpose, corresponding air flaps are typically provided but are not described in greater detail for the sake of clarity. The air outlet nozzles 8 lead to the side and central vents in the region of the dashboard. The air outlet nozzle 9 leads to defrosting openings below the windshield. The air outlet nozzles 20 are used for the front temperature control of the footwell. Provided parallel to the air distributing space 6 is a cold air duct or bypass 7 which can conduct cold air to the air outlet nozzles 8. The latter can be controlled by an air flap 15.

[0021] Directly below the air flap 15, an air outlet opening 13 is provided in the conditioning housing 1. The opening is part of a rear connecting section of the conditioning housing 1 - as seen in the normal direction of travel of the passenger vehicle. The air outlet opening 13 is surrounded by flange members in the form of profiles 14 which are used for centering or positioning various rear temperature-control units (Figures 1 to 3). The upper end of the connecting section of the conditioning housing 1 is provided by the flange members or profiles14 on the rear outer wall of the conditioning housing 1, approximately level with the outlet end of the air guiding duct 7 in the conditioning housing 1. An additional housing 10 which is open toward the conditioning housing 1 is attached to the entire connecting section. Thus, when the additional housing 10 of the rear temperature-control unit is attached, the rear outer wall of the conditioning housing 1 also forms the corresponding wall for the additional housing 10.

[0022] Further, in the region of the flange members 14 which are used for centering and positioning the additional housing 10 on the conditioning housing 1, sealing means are provided which ensure the tight, leak-proof connection of the additional housing 10 to the conditioning housing 1 and the air outlet opening 13. Fastening means are typically provided for securing the additional housing 10 to the conditioning housing 1 and for securing the tight, leak-proof connection but are not illustrated here for the sake of clarity.

[0023] The additional housing 10 forms an air distributing box in which a further heating unit 11 as illustrated, for example, in Figure 1 is integrated. The heating unit 11 is likewise provided with a left/right separation, but rather than being regulated on the water side, the heating unit 11 is regulated on the air side. For this purpose, a distributor flap 12 which can be activated by corresponding control or regulating means is provided in the additional housing 10. The additional housing 10 has a

plurality of air outlet nozzles 17, 19 which provide rear ventilation (air outlet nozzles 17) and footwell ventilation in the rear and side-window defrosting (air outlet nozzle 19). For this purpose, a further air flap 16 which distributes air between the footwell, defrosting and ventilation nozzles is provided on the output side of the additional housing 10. The ventilation nozzles, i.e., the air outlet nozzles 17, are connected via corresponding air guiding ducts to rear vents which are directed toward the seat positions of the rear passengers. The heating unit 11 is also provided with a left/right separation, such that the heating and air-conditioning system according to Figure 1 is a four-zone temperature-control means. Thus, in addition to the front region on the driver's side and front-passenger's side, the rear region lying behind the driver's region and the rear region lying behind the front-passenger's region can each be temperature-controlled separately.

[0024] In Figure 2, a two-zone variant of the conditioning housing 1 depicted in Figure 1 is provided. In the two-zone variant, the conditioning housing 1 as well as all of the functioning parts present in the conditioning housing 1 correspond to the design according to Figure 1. Accordingly, parts and units which are identical in construction and function are provided with the same reference numbers as used in the exemplary embodiment depicted in Figure 1. Only front temperature control is possible with the heating and air-conditioning system according to Figure 2. This is because the air outlet opening 13 arranged below the heating unit 4 and below the air flap 15 is closed here in a tight/leak-proof manner with a cover 18. The cover 18 is provided with plug-in or latching members which are matched to the flange profile members 4 of the conditioning housing 1, so that a tight, leak-proof fit of the cover 18 in the air outlet opening 13 is ensured. The cover 18 is preferably provided with additional sealing means, e.g., resilient seals, which are not described in greater detail here for the sake of clarity. Alternate designs

for the members covering for the solution according to the invention can be formed by cylindrical bodies, such as stoppers or the like.

[0025] In the exemplary embodiment according to Figure 3, a three-zone variant derived from the heating and air-conditioning system according to Figure 1 and from the heating and air-conditioning system according to Figure 2 is illustrated. In this embodiment, an air guiding arrangement 21 which makes rear ventilation possible and serves as the rear temperature-control unit is attached in the region of the air outlet opening 13. Separate and individual temperature control of the left and right side of the rear compartment is, however, not possible in this embodiment. Rather, only cold air which has been cooled by the evaporator 2 can be branched off from the conditioning housing 1 via the air guiding arrangement 21.

[0026] The footwell of the rear is temperature-controlled by air guiding ducts 20' which originate from the conditioning housing 1 by branching from front footwell ducts 20 as depicted in Figure 3.

[0027] All three heating and air-conditioning systems according to Figures 1 to 3 have the same conditioning housing 1. In order to obtain different temperature-control functions, modifications are merely made by closing the air outlet opening 13 or connecting the air outlet opening 13 to an air guiding arrangement 21 (Figure 3) or an additional housing 10 (Figure 1).

[0028] In the heating and air-conditioning system according to Figure 4, parts which are identical in function and structure to the exemplary embodiments according to Figures 1 to 3 are provided with the same reference numbers. Parts which are only identical in function, but deviate in manner of construction, are referred to by the same reference numbers, but with the addition of the letter a. In Figure 4, the fan or blower 23 which is positioned on the input side of the evaporator 2 and a fresh air inlet 22 which is connected upstream of the fan 23 are also illustrated.

These components are basically known and, therefore, do not have to be discussed in greater detail here. In addition, those parts of the conditioning housing 1a which are identical in function and/or construction are not described further for the sake of clarity. Reference is made in this respect to the description of the exemplary embodiments according to Figures 1 to 3.

[0029] In a manner similar to that depicted in Figure 1, an additional housing 10a (which is part of a rear temperature-control unit similar to the one shown in Figure 1) is attached to the conditioning housing 1a and is depicted in Figure 4. In addition, for the rear temperature-control unit, parts which are identical to the exemplary embodiment according to Figure 1 are provided with the same reference numbers, and parts which are identical in function, but not in construction, are provided with the same reference numbers with the addition of the letter a.

[0030] Figure 7, in a plan view, illustrates a cut-open part of the heating and air-conditioning system according to Figure 4. From this illustration, the left/right separation in the region of the conditioning housing 1a can be seen as the partition 28 which extends vertically and in the longitudinal direction of the vehicle being illustrated. In addition, it can be seen that the air outlet regions 8a are divided into central nozzles 29 and side nozzles 30.

[0031] The function of the rear temperature-control unit, which comprises the additional housing 10a, the air outlet regions 17a and 19a, the distributor flap 12a and the air flap 16, corresponds to the exemplary embodiment according to Figure 1. For further explanation, reference can be made to the exemplary embodiment according to Figure 1. The air guiding ducts 20a leading to the front footwell vents are indicated merely by dashed lines. Thus, the heating and air-conditioning system according to Figure 4 constitutes a four-zone variant similar to the heating and air-conditioning system according to Figure 1.

[0032] The heating and air-conditioning systems according to Figures 5 and 6 proceed from a conditioning housing 1a according to Figure 4, with an air guiding arrangement 24 being provided in the region of the air outlet opening 13a in the design according to Figure 5. This air guiding arrangement has a housing in which an air flap 27 is integrated. The air guiding arrangement 24 leads to rear vents which control the temperature of the seat positions in the rear region. The air flap 27 is used for admixing cold air to the footwell ducts 25 in the rear region. The footwell ducts 25 branch off from the conditioning housing 1a together with the front footwell ducts 26. Temperature control is also possible in a similar manner for the rear ventilation nozzles 17a, since the heated air which is supplied via the rear footwell ducts 25 may also be used for temperature control of the air supplied to the rear ventilation nozzles 17a depending on the position of the air flap 27. A left and right separation and also, accordingly, independent temperature control of the rear region on the left and right sides is, however, not possible. Thus, the exemplary embodiment according to Figure 5 is a three-zone variant.

[0033] In the exemplary embodiment according to Figure 6, a two-zone variant similar to the exemplary embodiment according to Figure 2 is illustrated. Here as before, parts which are identical in function and construction have the same reference numbers, and parts which are identical in function, but not in construction, have the same reference numbers with the addition of the letter a. The air guiding ducts 26 which branch off from the air distributing space 6a behind the heating unit 4 of the conditioning housing 1a are used for temperature control of the footwell in the front region of the vehicle interior.

[0034] The exemplary embodiments according to Figures 4 and 6 also proceed in each case from the same basic module, namely, the conditioning housing 1a to which different rear temperature-control units can be connected or whose air outlet opening 13a can be closed by a

cover 18a. Depending on the intended use, a two-zone variant, a three-zone variant and a four-zone variant can therefore be realized in a simple manner with the conditioning housing 1a itself not having to be changed.

[0035] The right of priority is claimed based on disclosure of German Patent Application No. 100 37 384.4, filed August 1, 2000, which is hereby incorporated by reference in its entirety.

[0036] The foregoing embodiments have been shown for illustrative purposes only and are not intended to limit the scope of the invention which is defined by the claims.